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ABSTRACT

This guide provides teachers of kindergarten through high school with model lessons relating to water conservation. Age-appropriate suggestions are presented including songs, poems, skits, activity sheets, and field trips. Generic hints and information are included in addition to material which applies specifically to New York City, such as how to read a water meter, and how a toilet works and how much water is consumed by certain activities. A bibliography for adults and children and a list of audiovisual materials are included. (VM)

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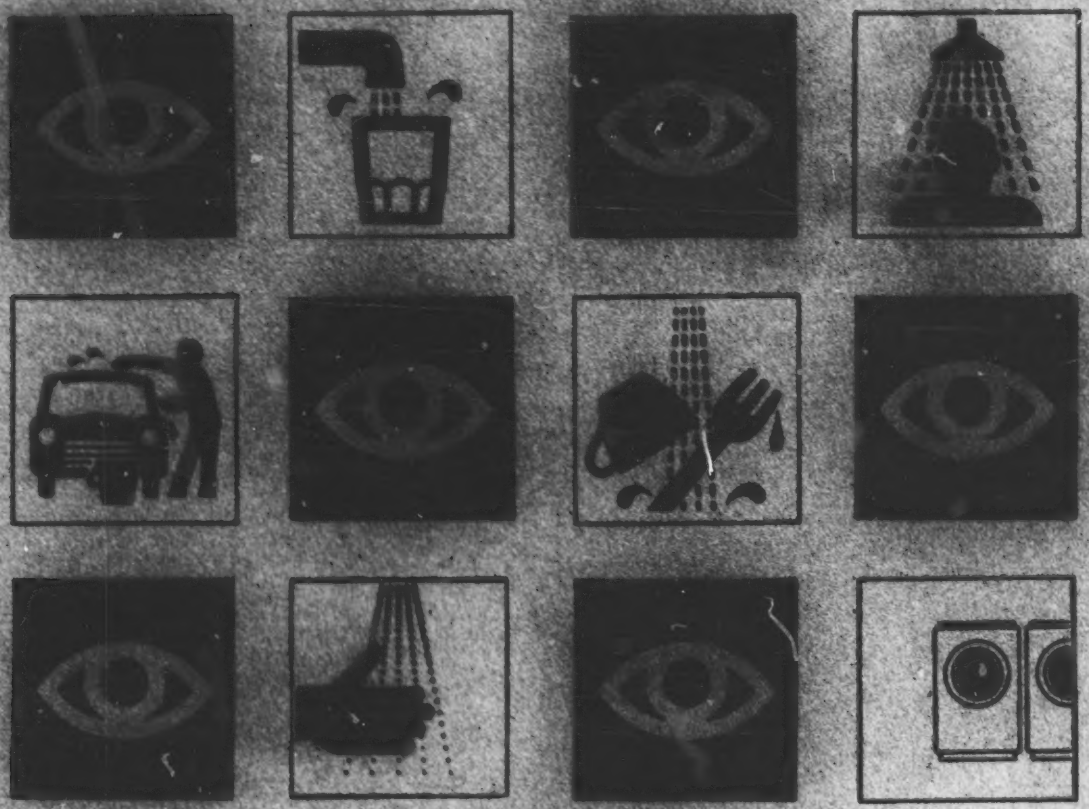
Be a Water Watcher

A RESOURCE GUIDE FOR WATER CONSERVATION
K-12



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A Message from the Chancellor

New York City is experiencing a serious drought. All residents of the city have been called upon to safeguard our threatened water supply. We must pledge ourselves as private citizens, as professional educators, and as students to support the citywide water conservation effort.

As educators, we can bring this important message to our students through water conservation lessons and activities. Be A Water Watcher has been developed to provide teachers and supervisors with a guide for accomplishing this task. Let us all join in this important effort to protect and conserve our most vital natural resource.

Nathan Quinones
Chancellor

Foreword

During periods of drought all New Yorkers are reminded that it is possible for our diminishing reserves of water to reach a dangerously low level. At such times we need to participate in a general conservation effort.

Teachers and students have demonstrated in the past that they can play a key role in heightening the water conservation efforts of their family, friends and community. Through our collective effort we can all develop an understanding of our need for water, our reliance on upstate water supplies, the finite nature of water reserves, and our role in implementing immediate conservation routines at home and elsewhere.

Education and cooperation are keys to solving our growing water problem. Therefore we ask every member of our school system to contribute to this vital campaign--before the tap runs dry.

Charlotte Frank

Charlotte Frank
Executive Director
Division of Curriculum and Instruction

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John Kominski, Assistant Director of the Science Unit, was the writer of this 1985 revised edition of Be A Water Watcher as well as a contributing writer in the previous edition.

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The Curriculum Editorial Unit, under the direction of Alaire Mitchell, Assistant Director of Curriculum Research (Acting), prepared this book for publication. Editing and production were done by Susan Maria Grathwohl. Cover by Tom Wright.

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Introduction

The watershed areas to the north of New York City collect rainwater and snowmelt in streams, natural lakes, and reservoirs. Gigantic aqueducts carry the water to the metropolitan area where it is distributed to our neighborhoods and homes by a complex network of mains, valves, and pumps. Ultimately the water reaches our faucets and taps for cooking, washing and other uses including commercial uses for the manufacture of goods and the delivery of services. In addition, hydrants supplied with water from these same reservoirs provide firefighters with our primary defense against destructive fires.

It all adds up: New York City consumes 1.4 billion gallons of water each day.

On February 25, 1985 the City of New York declared a Drought Watch for its water supply system. A "Drought Watch" is declared when there is less than a 50 percent possibility that the major components of the reservoir system (the Catskill and Delaware Systems) will fill by June 1st. During a Drought Watch, additional water is drawn from the Croton System and voluntary conservation efforts are urged.

A "Drought Warning" is declared when there is less than a 33 percent probability that either the Catskill or Delaware System will fill by June 1st. Such a Drought Warning was declared in New York City on April 3, 1985, requiring government agencies to cut back on their use of water.

A "Drought Emergency" indicates that the reservoir system is so low that stringent means are necessary to assure that reservoirs are not drained during a lengthy dry spell. Severe restrictions on water use are mandated: These conservation measures can be enforced by inspectors through the imposition of fines. A Drought Emergency was declared on April 26, 1985.

How to Use This Bulletin

Be A Water Watcher (1985) provides teachers with materials suitable for all levels. "Part I: Elementary" features a model lesson and many suggested activities, together with Activity Sheets. "Part II: Secondary" presents model lessons in Communication Arts, Social Studies, Science and Industrial Arts, along with suggested activities and Activity Sheets with interdisciplinary application.

Be a Water Watcher (1985) also contains an abundant selection of materials in the final section, "Resources for the Teacher." These primary source documents, and the bibliographies which follow, allow for flexibility in integrating this topic into curriculum planning.

Teaching about water can be further implemented by the following lessons appearing in standard Science Curriculum Guides.

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Part I: Elementary

Suggested Activities are provided both by general category and grouped by grades. The needs and objectives of each class will help you determine which activities and activity sheets to use.

Elementary Model Lesson

MOTIVATION

Show pictures of people using water in various ways, e.g., tub bathing, watering pets, washing car, washing dishes, drinking, shaving, fire fighting, etc. Ask "What do these people have in common?"

AIM Why is water important to us?

DEVELOPMENT

. List all the ways your family used water this week. Include pets, plants, cooking, cleaning, etc.

. Collect pictures of people using water. Create a bulletin board display focusing on the importance of water in our lives.

. Share a story about the importance of water in our lives. Act out the story or use puppets.

. Discuss: How do some people waste water? What might happen if we run out of water? Relate drought to famine and review the plight of people living in present day famine areas like Ethiopia and Sudan.

. Visit museum dioramas and habitat displays in zoos that illustrate desert life around the world.

SUMMARY

. Discuss the phrase: "Be a water watcher." Why is it important to be a water watcher?

. How can we help save water in our own homes (especially in the bathroom)?

ADDITIONAL ACTIVITIES

The following Activity sheets maybe distributed to supplement the development of this aim depending on the needs of the class:

- Activity Sheet E1, "Water Report Card"
- Activity Sheet E2, "The Water Wasters"
- Activity Sheet E3, "Poetry, Song and a Skit"
- Activity Sheet E4, "Don't Be A Drip!"

Suggested Activities

(General)

. Collect food packaging and labels showing ingredients. Generalize that water is often the most prominent ingredient in packaged foods. (Note that ingredients are presented in order of their abundance, usually by weight, in a product.)

. Compare dried fruits and vegetables to their fresh counterparts. Rehydrate dried produce by soaking in water. Dry slices of fruit or pieces of vegetable on screens in the sun. (Consult a natural foods cookbook.)

. Develop a water report card (see Activity Sheet E-1). Who should use a water report card? If used at home, how can you get others in family to cooperate in the effort? How could you remind others at home to save water without becoming a nuisance? How can you measure your family's water savings? How much water can your class save in a week?

. Using pictures and diagrams, discuss how water gets from a reservoir to our homes. Trace the aqueduct pathway for water on a road map with yarn or markers.

. Make posters advising people on ways to save water. Ask local shopkeepers to display posters in their windows.

. Conduct an assembly program which focuses on water, its importance, uses, and ways to conserve. (See Activity Sheet E-3 "Poetry, a Song and a Skit," which was used in an auditorium program held at P.S. 124 Manhattan.)

. Review the concept of volume and how it is measured. practice converting from standard to metric units, e.g., from gallons to litres. the amount of water needed for everyday activities can be used in this exercise (see "Resources for the Teacher").

Grades K-2 *

. Ask the students if they know where the water in their homes comes from. List all of their answers on the board. Then, draw a simple sketch of rain clouds, rivers, reservoirs, tunnels and pipes leading to a building. Keep the sketch very simple.

. Explain that water flows from the reservoirs, through the pipes, and into our homes. Explain that if one lives in a tall building, water is held in a water tank on rooftops.

. Take a walking tour of your neighborhood and see if the students can identify the buildings with water tanks. (Some are very cleverly concealed.) Notice how tall the buildings are that have such tanks. Ask the students to draw pictures of how water comes into their homes. A group of students should make a diorama of this water-transfer system.

. Ask the students if they know what the word "plumbing" means. Discuss how the household plumbing mechanism includes the way clean water enters our homes, and the way unclean water leaves our homes. Ask students to list the ways water enters our homes (e.g., faucets, taps, toilet tanks, etc.), and how water leaves our homes (drains, toilet bowls, etc.). Explain that these are two separate systems. Ask students to discuss problems that occur with plumbing in their homes (e.g., stoppages, leaky pipes and faucets). Discuss methods to prevent such problems. Draw posters showing how to avoid those problems and save water.

* From the two-volume resource manual for teachers called Home Sick? Try House Sense!, developed by the Department of Housing Preservation and Development in cooperation with the Board of Education and with the help of eleven other city agencies, and written by Dr. Kathleen D. Morin.

Grades 3-6

. As a class project, students should construct a three-dimensional in the classroom or hallway which will show how water travels from upstate reservoirs into their city apartments. Use string, tinfoil, cotton (perhaps for clouds), popsicle sticks (perhaps for water tower?), and straws (pipelines), to recreate the water works system. Guide students, step by step, in this process.

. Visit a local reservoir. Draw a picture of it. Research when it was built, how much water it holds, what occupied that site before the reservoir was built, and what restrictions there are on its use.

. Ask the school custodian to show your class the system of pipes by way of which water enters and leaves the school building. Students will draw a flow chart of the school's plumbing.

. Ask the students to discuss any plumbing problems they have had in their homes. Discuss the two plumbing systems in our buildings (input and drainage). Explain that drainage pipes have a U-shaped bend to prevent sewer gas from entering our homes, and that water stops the flow of such gas. Draw a large drain pipe and show how certain objects cause stoppages. Ask students to design posters showing objects that should not be put into the drainage system.

. Pretend you are a drop of water in a cloud. Write a poem or a story about your travels to a New York City home.

Grades 6-9

. Explain the basic plumbing system, input and drainage, found in our buildings. Explain that buildings taller than six stories require water towers because ground-level pressure is not strong enough to force the water above the sixth floor. Using a bowl and a hose, demonstrate how water seeks its own level. This is the basic theory for the use of gravitational water tanks. Walk through the neighborhood with the students and ask them to sketch the variety of styles of towers. Find hidden water tanks on the tops of buildings.

. Students will estimate and/or measure the amount of water they use each day. They will list and graph their water usages, and analyze how they can save water.

. Invite a local plumber to visit your class to discuss his/her profession, and to tell students how they can avoid plumbing problems at home or sponsor an assembly program and invite the Cornell University Cooperative Extension Handi-Van (587-9740) to visit your school. You can ask to have a representative talk to the students about household systems, including plumbing. Students will compile a list of plumbing mistakes to avoid in their own lives.

. Ask students to analyze how water is wasted in their building and in their neighborhood. Conduct a survey, and ask students to create a photo essay for a local or school newspaper on the topic of how and why water should be conserved.

Activity Sheets —

Elementary

Activity Sheet E-1, "WATER REPORT CARD"..... 8
Activity Sheet E-2, "THE WATER WASTERS"..... 9
Activity Sheet E-3, "POETRY, A SONG AND A SKIT"... 12
Activity Sheet E-4, "DON'T BE A DRIP!"..... 17

Water Report Card

Name _____ Class _____ Date _____

Use a checkmark (/) to show how you use water:

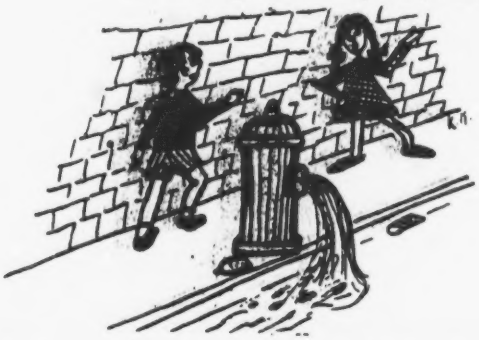
	Always	Sometimes	Never
Do you take long showers?	____	____	____
Do you let the water run while brushing your teeth?	____	____	____
Do you take baths in a full tub of water?	____	____	____
Do you have leaky faucets at home?	____	____	____
Do you open fire hydrants for fun?	____	____	____
Do you keep this number (212) 966-7500 near your telephone to report open fire hydrants?	____	____	____
Do you use the toilet as a trash can for gumwrappers and facial tissue?	____	____	____
Do you get a cold glass of water by letting the tap run?	____	____	____
Do you try to keep your clothes clean to avoid unnecessary washing?	____	____	____
Do you keep a jug of drinking water in the refrigerator?	____	____	____
Do you give your pet water each day?	____	____	____
Do you water the houseplants?	____	____	____
Do you need water?	____	____	____

Activity Sheet E-2

The Water Wasters

DIRECTIONS: Study the situation described below. Then answer the questions. Share your answers with your class.

ACTIVITY: You are walking down the street on a hot summer day. You see your friend beginning to open a fire hydrant. He wants to play in the cool water, and his older brother wants to use the water to wash his car. You have learned in school that it is dangerous to open hydrants. What will you do? How do you feel?



How do you feel? (check)

_____ Angry

_____ Worried

_____ Scared

_____ Concerned about fire safety

_____ Other (Explain how you feel.)

_____ Eager to join in the fun

_____ Concerned about water waste

Briefly explain HOW YOU FEEL and WHY YOU FEEL that way: _____

_____

_____

_____

What will you do? (Check one or more.)

_____ Keep on walking and pretend you did not see your friend open the hydrant.

_____ Tell your friend not to open the hydrant! And then explain WHY he should not open the hydrant.

_____ Tell the older brother that he should not use water from the hydrant to wash his car.

_____ Run home and tell your mother what you saw.

_____ Run home and call 966-7500 to report the open hydrant to the New York City Department of Environmental Protection. You will talk to your friend and his brother about the dangers of opening a fire hydrant without using a spray cap at a later date.

_____ Other. If you will not do any of the above, state what you will do.

_____

_____

CONCLUSION: Share your answers with your classmates. Role-play the situation. Discuss your feelings and alternative strategies. State three reasons <u>why</u> it is very dangerous to open fire hydrants.

1. _____

2. _____

3. _____

Adapted from <u>Home Sick? Try House Sense!</u>, by Dr. Kathleen D. Morin. Copyright (c)1982 by Department of Housing Preservation and Development, New York City. Reprinted by permission.

DANGERS OF AN OPEN HYDRANT.

1. If several hydrants are open in one neighborhood, there can be a serious loss in local water pressure. This can make it very difficult for the Fire Department to fight fires that occur in the neighborhood.

2. A drop in water pressure due to several open hydrants in one neighborhood can result in a lack of drinking water and an inability to flush the toilets. There will not be enough water pressure in the area to produce enough water for these routine and necessary houshold functions.

3. An open hydrant can be dangerous because it releases almost 1,000 gallons of water per minute. The force of this water flow could knock a person over easily and result in injuries. Children have been pushed into the path of moving vehicles by a hydrant's powerful flow.

   NOTE: Normally during the summer months, spray caps have been supplied, so that communities can open fire hydrants for safe recreational use. Unfortunately, however, this year the drought is so severe that spray caps will not be available. Furthermore, because of drought restrictions, opening a fire hydrant is punishable by a fine of up to $1000.

FIRE HYDRANTS

Student Objectives:

★ to explain how to report a broken or gushing fire hydrant

Suggestions to Teachers

• flooding in streets can cause sewers to back up, weaken foundations, obstruct traffic, cause brake failures and engine stallouts.

• pipe wrenches used to illegally open hydrants often strip the control nut on top, so that it is hard to open the hydrant in a real emergency.

• a damaged or abused hydrant is turned off at the underground valve which means that fire fighters may have to waste valuable time in locating a working hydrant and running extra hose to the fire.

• an open hydrant wastes 1,000 gallons per minute.

Open hydrants should be closed by an adult or reported to the local fire station or police precinct, or call 966-7500.

Adapted from Fire Prevention and Safety, A Teacher's Handbook, 1984-1985.

THE WATER WASTERS: GARDEN HOSES

Many schools, classes, and community groups have planted trees and flowers in order to beautify their neighborhoods, for example on Arbor Day. In addition, these schools and groups have planted vegetable gardens throughout New York City. Restrictions on the use of water during a drought affect these programs.

. List several reasons why people use garden hoses.

1. _____ 4. _____

2. _____ 5. _____

3. _____ 6. _____

- Which use of water is the most important? Explain.
- Which use of water is the least important? Explain.
- Which activity uses the most water?
- How would you decide if water is being wasted or used wisely?

Note: Garden hoses, fully open, deliver about 10 gallons of water per minute.

- How would you determine how much water flows out of your garden hose each minute? (Hint: use a 2-gallon bucket and stopwatch. Be sure not to waste the water you collect!)

During this drought emergency the Department of Environmental Protection does not permit:

1. The washing of any vehicle by means of a hydrant or hose
2. The washing of any street, sidewalk, driveway, or building exterior
3. The use of any water from any source for ornamental fountains

City water may be used to water lawns and ornamental plantings only between the hours of 7:00 a.m. to 9:00 a.m., and 7:00 p.m. to 9:00 p.m. according to this schedule:

- At odd-numbered addresses, water may be used during the hours specified on odd-numbered days of the month.
- At even-numbered addresses, water may be used during the hours specified on even-numbered days of the month.

However, City water may be used at any time to irrigate, from a hand-held containers, vegetables or fruits being grown for human consumption.

. Follow up Activities:

- Develop a schedule of days and times that your home or school may water lawns, trees, and shrubs. How can you keep Arbor Day trees properly watered according to this schedule?
- Supply school and community vegetable gardens with suitable hand-held watering containers.
- Make and display posters reminding gardeners of the drought regulations.

Activity Sheet E-3

Poetry, a Song and a Skit

The following poems were written by Class 6-1 of P.S. 124M, Ms. F. Bochinis, teacher. The students reading in an assembly program were Mee Ling, Marie Wong, Stacey Cheu, Garmon Ng, and Susan Lau.

CONSERVE WATER

Water provides many needs,
To save water is one of our most important deeds
Water doesn't come from the sun,
So don't waste it before it's gone!

Don't sit back and watch the water run,
Don't think it's a lot of fun.
If we all take a gigantic part,
We'll have a happy feeling in our hearts!

Water is an important source,
So you have to save it, of course.
We need to save the water badly,
Or we'll live very sadly!

People that waste water are fools,
So don't be like that, too.
If you don't save water you will regret it,
And in the future you will not forget it.

Conserving water is important to us,
You don't put a minus - you put in a plus.
We all have to dig in for a solution,
So lay back and think for a satisfying conclusion!

WHERE DID ALL THE WATER GO?

Where did all the water go?
It went when the wind blew.
It was a very bad thing to know,
When all the water had to go!

A drop, A drop,
Is so important to the crops.
Life will get tougher,
And we'll have to suffer!

The sun took the water and never gave it back,
Now it's like looking for a needle in a haystack.
We will regret it for the rest of our lives,
Because we didn't conserve it right!

The water was something we all need,
We use it to feed the appleseed.
The water has gone up into the sky,
Now that it's done, I want to cry!

The water disappeared on a drastic day,
When everyone wished that it would stay.
We all know it won't be back,
And that was this and this was that!

SONG - TOMORROW*

We need some water for tomorrow,

So you've got to keep it for tomorrow.

Come what may.

When you're stuck with a year that's dry, and dirty,

You've got none to blame

So save, today ---------

Tomorrow, tomorrow, there'll be enough water,

If we can conserve today.

*Song to the tune of "Tomorrow" from the broadway show "Annie."

Words by Class 5-1, P.S. 124M, Teacher: Mrs. A. Goodstein.

ORIGINAL SKIT*

A Man Called Oscar, the Water Waster

Announcer: Dear friends, Class 5-1 is proud to present an original skit on water conservation, A Man Called Oscar the Water Waster.

Scene 1

Narrator: Oscar retires for the night leaving the water faucet open and the dishwasher on with only 2 dishes inside. (Suddenly an unexpected visitor appears.)

Oscar: Bah, waterbug! I left the water faucet and the dishwasher on. Oh! Who cares!

Sam (Ghost No. 1): Oscar, Oscar Mortimer? Why are you wasting all that water?

Oscar: Who's that? (Shaking)

Sam: I'm your old friend, Sam.

Oscar: (Wheels around quickly.) Sam, is that really you? You're alive! You've been dead for seven years.

Sam: Why did you keep the water faucet on and the dishwasher running?

Oscar: Bah, waterbug! Sam. There's plenty of water in New York City.

Sam: There is water, but the supply is dwindling because of water wasters like you. Come with me into the past and I'll show you how foolishly you've wasted water.

Scene 2

Sam: Do you remember Oscar? Look!

Oscar (as child): (Laughs aloud. Little Oscar turns the faucet on full blast.) Oh this will make a great swimming pool.

Sam: Look closely, Oscar.

Oscar: Can it be? Yes, that little boy is me! Me! Now I remember the time I tried to make a swimming pool in the basement. Boy, was that funny...

Sam: Funny? Many New Yorkers wouldn't agree that wasting water is funny.

Oscar: Bah, waterbug! I keep telling you there's plenty of water in New York City.

Sam: Oscar, not so. Come with me to see some of your friends and you'll see differently. (EXIT)

* Presented by Class 5-1, P.S. 124M, Teacher: Mrs. A. Goodstein

Scene 3

Oscar: Where are we?

Sam: The Year is 1987.

Oscar: Why, that's my friend, Felix. What's happened to him?

Sam: Look closer, Oscar.

Oscar: Felix, you're filthy? You used to take 5 showers a day. Now, your hair is dirty. Your clother are filthy, and bah waterbug, your kitchen floor's a mess.

Felix: Oscar, I'm miserable. We have so little water left that I can hardly take showers, and you know I'm only happy when I'm clean.

Oscar: No, no more, I feel guilty enough.

Sam: Dear friends (faces audience), what will happen to our water supply when water wasters like you are around?

Oscar: My friend, Felix, he was so clean. Now look at him - his clothes are dirty, his kitchen floor is dirty. What's happening?

Sam: All the people in New York City are looking for water for cleaning, bathing, cooking, drinking and washing. They have none because people like you carelessly and selfishly used it up.

Oscar: What can I do? Is it too late?

Sam: It's never too late. You and all New Yorkers have to be creative and think of ways to save water.

Oscar: (Gestures to audience.) C'mon everyone. Let's think of ways we can conserve water in our homes.

(Four children come up.)

1. Use the dishwasher and washing machine only when there is a full load.

2. Take showers, not baths. Conserve water.

3. Keep all faucets tightly shut.

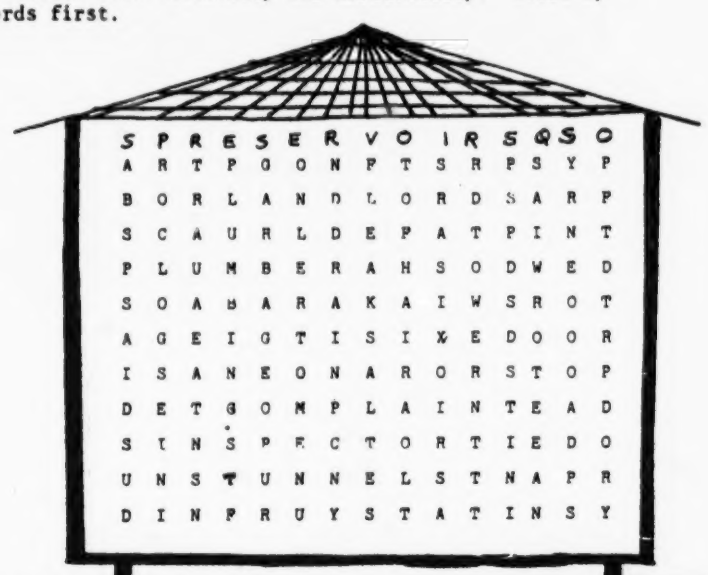
4. Only use water when absolutely necessary.

5. Remember! Everyone! Keep New York City Wet (Cheerleaders).

Don't Be a Drip!

DIRECTIONS: Here is a puzzle to see how much you know! Hidden in the maze of letters below are thirteen words about water and plumbing in your home. See if you can find the words and match them with the appropriate "fill-in-the-blanks" questions listed.

When you find a hidden word, circle it. Write the word in the proper space. You will find the words hidden both vertically and horizontally. Start by finding all thirteen words first.



S	P	R	E	S	E	R	V	O	I	R	S	Q	S	O
A	R	T	P	G	O	N	F	T	S	R	P	S	Y	P
B	O	R	L	A	N	D	L	O	R	D	S	A	R	F
S	C	A	U	R	L	D	E	F	A	T	P	I	N	T
P	L	U	M	B	E	R	A	H	S	O	D	W	E	D
S	O	A	B	A	R	A	K	A	I	W	S	R	O	T
A	G	E	I	G	T	I	S	I	X	E	D	O	O	R
I	S	A	N	E	O	N	A	R	O	R	S	T	O	P
D	E	T	G	O	M	P	L	A	I	N	T	E	A	D
S	I	N	S	P	E	C	T	O	R	T	I	E	D	O
U	N	S	T	U	N	N	E	L	S	T	N	A	P	R
D	I	N	F	R	U	Y	S	T	A	T	I	N	S	Y

Fill in the blanks.

1. _____ is the name we use for all of the pipes, valves, and fixtures which move water throughout our buildings.
2. Water comes to the City from large _____, man-made lakes, many of which are located upstate. The water travels here through _____ and pipelines.
3. A _____ is the person who repairs water pipes, valves, and fixtures when they do not work well.
4. Stoppages, which we often call _____, in drain pipes can be unpleasant, unsanitary, and costly to repair.
5. We can prevent stoppages by never throwing toys, bottles, paper towels, or _____ down the toilet or drains.
6. Grease, garbage, and _____ are common causes of clogs in the drains of our tubs and sinks.
7. Our _____ are responsible for providing tenants with adequate plumbing fixtures, such as toilets, sinks, and pipes, for bringing water into our homes and for draining waste waters out of our homes twenty-four hours each day. They must also keep the basic plumbing system in good repair. But we as tenants must also act responsibly and use the plumbing system properly.
8. Water should be used wisely and never wasted. We should check for and repair _____ in pipes and faucets.
9. If you live in a building more than _____ stories high, you probably have a tank or water-_____ on your roof. This is because the water pressure at street level is not strong enough to force water up to all of the apartments in your building.
10. In our homes, there are two separate plumbing systems. The INPUT system brings water into our homes. The OUTPUT, or _____ system, takes waste water out to the sewer system.
11. If your superintendent or landlord does not repair serious plumbing problems, call 960-4800 - which is the number of the City's Central Complaint Bureau. If the problem is not corrected the Bureau will send an _____ out to examine the situation.

Activity Sheet E-4 (continued)

CONCLUSION: Write two ways in which you can reduce the amount of water used in your home.

1. _____ 2. _____

_____ _____

_____ _____

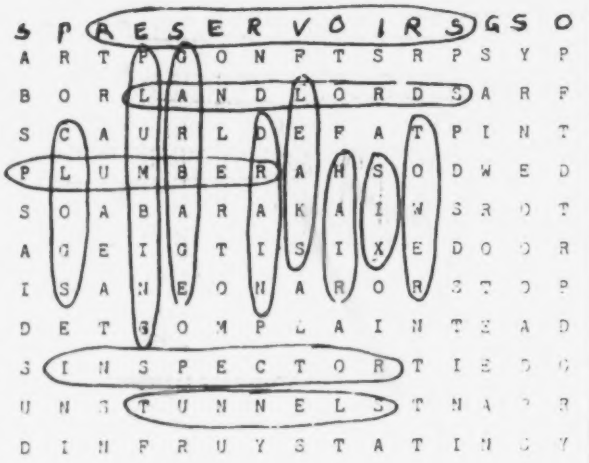
SHARING:

Take this worksheet home. Ask your family to find the hidden words and fill in the blanks. Discuss their answers with them. Ask them if they have ever had plumbing problems, what caused them, how they fixed them, how much it cost, and how they are working to prevent such problems in the future.

If they are having plumbing problems now, ask them to read questions #7 and #11. Show them the answers, and discuss what you should do. To report open hydrants, water supply, and water pollution problems, call the city's Department of Environmental Protection (966-7500).

ENRICHMENT: In the space below, design a poster showing one or more ways to conserve water in your home. Post your design on your refrigerator or home bulletin board as a reminder. Or use this space to design a "Water-Saver" button. Cut it out and wear it. Do this in class, or at home with your family.

Answers to Puzzle



1. plumbing
2. reservoirs, tunnels
3. plumber
4. clogs
5. garbage
6. hair
7. landlords
8. leaks
9. six, tower
10. drain
11. inspector

From Home Sick? Try House Sense!, by Dr. Kathleen D. Morin. Copyright (c)1982 by Department of Housing Preservation and Development, New York City. Reprinted by permission.

Part II: Secondary

Water conservation affects all areas of our lives and our society. The following Secondary Model Lessons, Suggested Activities, and Activity Sheets may have application to all disciplines in the secondary curriculum. Although presented by separate categories for the purpose of organization, these materials can be adapted for creative use in more than one area of study. The needs and interests of each class are your best guide in determining which materials and activities will be most effective.

For example, Communications Arts classes might make use of materials introduced with Science. Similarly, Industrial Arts classes might benefit from activities initially suggested for Communication Arts or Social Studies.

Secondary Model Lesson: Communication Arts

MOTIVATION

You have been appointed chief in charge of saving water. What are some of the ways you can influence people to conserve water?

AIM How can we write a slogan to promote water conservation?

ACTIVITIES

- Define "slogan."
- Give examples of some slogans you have heard, e.g., "I love New York," "Don't dump on New York," "It's a matter of life and breath," "The life you save may be your own."
- What are the qualities of a good slogan? (Short, catchy, clear message)
- In small groups, develop some slogans for water conservation.
- Draw posters to illustrate each slogan and then create a bulletin board display focusing on water conservation.

Note to the teacher:

Slogan [slo-gan], noun [1] A motto, phrase, catch word or similar oft repreated expression that is associated with some product, service, group, campaign or effort. [2] A rallying cry
The word slogan came from a Gaelic expression used in Scotland to describe the "war cry" or "gathering cry" for Highland clans.

SUMMARY

- Give an example of a good water conservation slogan and explain how it illustrates the qualities of a good slogan.

Suggested Activities

1. Write and deliver a persuasive speech, urging people to conserve water.

2. Write a newspaper article which describes steps that everyone can take to save water.

3. With an art class: Team up with an art class to save water. Develop some campaign slogans for water conservation and ask an art class to make posters illustrating them. Write a business letter to a local bank, post office, or library, requesting that the posters and art work be displayed.

4. Write a short story about what life in New York City would be like ten years from now if the water emergency continues.

5. Write a report on how we use water and how we waste water.

6. Using the news articles in the "Resources for Teachers" section of this guide and/or Activity Sheet S-1, delete key words from some of the passages. Have students supply missing key words. Follow up with a class discussion regarding why students selected the words they did.

7. Water has provided inspiration to artists and writers throughout history. Review works of poetry, prose, music, dance and art inspired by water themes.

8. Search collections of quotations in the reference section of the library. Find water statements that are important to you and explain why.

Secondary Model Lesson: Social Studies

MOTIVATION

These headlines appeared in New York City newspapers:

- City, Its Reservoirs Low, Is To Cut Water Use
- City Warned to Save Water For The Fall
- No Singing In The Rain For New York

Discuss: Why are headlines such as these are becoming a common sight in our newspapers?

AIM How will a water shortage affect our daily lives?

DEVELOPMENT

. Why are we experiencing a water shortage?

. How have residents of N.Y.C. added to the problem?

. Why don't people routinely conserve water in their daily lives?

. How much water does the average person use each day? How would you determine the amount of water used by you each day? Which activities use the greatest amount of water?

. How would your life change if you had to use 75% less water than you do now?

. Divide the class into small groups. Give each group the following task. "You are a special committee appointed by the mayor to draft a plan of action for citywide water conservation. Develop a plan and be ready to present it to the mayor in 20 minutes." After the groups are finished, each should make a brief presentation to the class. Discuss which of the methods suggested could be implemented today by members of the class and their families.

. Relate drought to the famine conditions that face countries around the world today.

SUMMARY

. What can each of us do at home and at school to save water?
. How can we encourage others to conserve our water supply?

Suggested Activities

1. Debate the following "solutions" to the water shortage:

    . Make people pay for their water, like electricity

    . Turn off the water periodically each day

    . Heavily fine anyone washing their car with a hose

    . Issue water ration coupons and dispense water from a central location in the city

2. Discuss the impact of a serious water shortage on democracy. Try to determine how the scarcity of an essential resource affects the politics of a region. What effect does it have on the distribution of power in a community, and how does power influence what solutions are used to control a shortage? For example: With limited resources, who decides how to use the water we have? How is the decision arrived at? How is it implemented? Can "panic" during a shortage lead to a fascist-like government with repressive police action? By discussing these topics, students see that water shortage, besides having enormous direct effects on lifestyle, may also have impace on freedokm and the political rights of citizens.

3. As a class develop a water conservation campaign for your school. Include art work, public address announcements, and neighborhood outreach work. **NOTE: Classes may wish to work with members of the general organization to implement the program. At the high school level, student leadership classes would become involved in the project.

4. Research the effect of increased suburban development on the quality and amount of waste that collects in reservoirs upstate.

5. Have students act out the following skit. The class should then discuss the following questions:

    . According to this story, why does New York City become a ghost town?
    . Who is to blame for the situation described?
    . How could the situation have been avoided?

Imagine that a group is riding on a spaceship in the year 2001 A.D.:

Tour Guide: (Speaking into a microphone) And now we are entering another old ghost town where our forefathers dwelled and once prospered.

Tourist #1: Was there once a nuclear war here? I mean, so many buildings look burned out.

Guide: No war. Just fires. What you see here are the charred remains.

Tourist #2: But surely even in the year 1985 they must have had firefighting knowledge. Couldn't these disasters have been prevented?

Guide: They had a fire department and fire-fighting equipment, crude as it was back then, but the main item--water--was in short supply.

Tourist #3: How could the supply get so low that a whole town virtually burned down?

Guide: Methods of controlling and inducing rain were primitive back in 1985. They had to depend on the graces of nature. During drier periods, water conservation was needed. Without successful water conservation, these people perished. People had to move to more rain-rich areas--scarce as those were--and what ever was left rotted or burned.

Tourist #4: What alternatives did those people have?

Guide: They could have listened to the early warnings of officials about low water levels in reservoirs and stopped wasting the precious liquid. They could have fixed leaky faucets in their homes; they could have taken showers instead of baths; they could have refrained from washing cars and watering lawns or running a half-full washing machine. But no, they didn't bother. They thought the problem wasn't serious and would go away by itself.

As the group is leaving the ship, the guide and the tourist notice a sign on the ground. It says, "42nd Street--Times Square."

Secondary Model Lesson: Science

MOTIVATION

In medieval Europe water demand was only 3-5 gallons per day per person. Approximately how much water does each of us use each day? Why has our water consumption increased:

AIM Why is it important to control our water consumption?

ACTIVITIES

. It is estimated that each New Yorker uses about 180 gallons of water each day.

. What daily activities require water?

. Predict what your life could be like if water was rationed to 5 gallons per day. Recall life in medieval Europe.

. How much do we use for each of these activities? How can we reduce each of these amounts? How much can they be reduced?

. Devise a way of calculating the daily water loss from a leaky faucet. (Hint: Use a stopwatch and calibrated container.) Try the method at home and report your results. Have any leaky plumbing in your home repaired.

. Which season probably creates the highest demand for water? Why? Why is this a source of concern for New York City officials?

. Where does New York City water come from? Where is it stored? How does it reach the city? Locate the NYC watershed areas and trace the aqueducts downstate on a New York Road map.

. Compare the reservior levels today with those of a year ago. Where in a library can you find this data? Can you find graphs that illustrate this information?

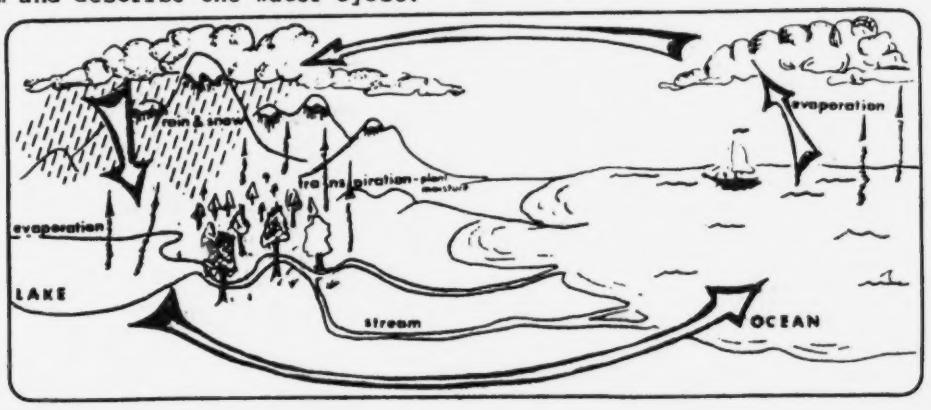
. How can we calculate the total amount of water saved by our class in one day? one week? one year?

SUMMARY

How can we help in the New York City water conservation effort?

Suggested Activities *

1. Diagram and describe the water cycle.



2. Identify the factors which may contribute to a water shortage, e.g., supply vs. demand, pollution, inadequate distribution systems, etc.

3. Review techniques for measuring volume. Determine the volume of a classroom in cubic feet. Calculate the amount of water that would be needed to fill a classroom (1 cu. ft. 7.5 gal.) At the rate of use of 100 gal/day/person, how long would the supply in the room last?

4. Research industrial uses of water, e.g., cooling machinery, chemical production, refrigeration, etc.

5. Research how "grey water" - relatively unpolluted waste water - can be used in landscaping applications, cooling and other commercial applications.

6. Construct a solar still which can desalinize seawater.

7. Read Activity Sheet S-1, "New York gets the Dry Look." Discuss Douglas Paine's prediction of drought in the future for New York City. Have his predictions come true? Consult an almanac for annual rainfall data. Speculate on the problems that will face New York if a drought trend develops and continues.

8. Use a map of New York State (a road map will do) to locate the major dams in the state. Use Activity Sheet S-2, "List of Dams," to study and compare the size and shape of the reservoirs and lakes controlled by each dam. Determine the direction of the drainage pattern within the watershed area. Relate this map to Activity Sheet 3, "Maps Illustrating the New York City Water Supply System."

   Note: There are more than 6000 dams on New York State waterways. For more information, write to New York State, Department of Environmental Conservation, Dam Safety Section, 50 Wolf Road, Albany New York 12233-0001.

9. Develop a bulletin display illustrating the characteristics of a watershed and the importance of forest management in maintaining water resources. Sample attached.

*Many activities and lessons are to be found in the science curriculum Consult "Resources for the Teacher" for full references.

Secondary Model Lesson: Industrial Arts

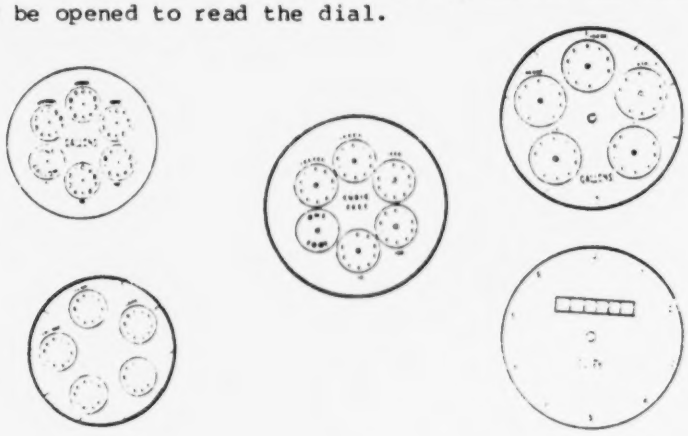
MOTIVATION

Display samples or pictures of various meters (odometer, speedometer, dial thermometer, aneroid barometer, flow meter, clock, voltmeter, pedometer and water meter. What do these devices have in common? How are they different? Which would be useful in conserving water?

AIM How can we measure water use?

ACTIVITIES

. Distribute copies of Activity Sheet S-4, "Reading Water Meters." Explain that a paddle wheel or fan-like device in the water meter spins as water flows through the pipes. A gearing system translates this spin into indicator movement on the dial. Water meters commonly measure the number of gallons or cubic feet consumed. Water meters are located in the plumbing system where the outside water main enters the house - usually in the cellar, basement, meter room or in a concrete lined pit in the ground. A hinged metal cap covers the dial face and can easily be opened to read the dial.



Cumulative-reading meters are composed of several smaller dials each of which is calibrated in multiples of 10 (i.e., 10; 100; 1000; 10,000; 100,000). Each dial is read separately, then combined to determine the volume of water used. Caution: some of the smaller dials record and are read clockwise while others move counter-clockwise.

Direct reading water meters resemble the speedometer/odometer dial on an automobile dashboard. These meters can be read quickly and also measure either in cubic feet or gallons. Metric water meters are also produced.

- Discuss how the one foot or one gallon dial can be useful in detecting leaks. The indicator on this dial moves quickly as water flows through the meter. One revolution on this dial indicates one gallon or one cubic foot of water used. If all faucets and values have been shut off at home (no water use), movement of this dial pointer indicates that a leak exists somewhere in the plumbing system.

- Practice reading the water meters on Activity Sheet S-4. Meters A and B both read 54,862 gallons, i.e. [50,000 + 4,000 + 800 + 70 + 2] gallons as indicated by each dial on the meter. Meters C, D and E each read 51,973 cubic feet.

- Use Activity Sheet S-5, "Water Meters," to make up your own practice problems. Simply draw in the pointers. Remember that when a pointer is between two numbers, the lower number is recorded.

- Discuss how weekly water meter readings could help a family or business analyze its consumption.

- Using weekly readings, how would one determine average daily water consumption? How would you determine the amount used per person in the household in one day? If a water meter could record time of use as well as amount used, at what time of day would your household use of water be recorded as highest? Lowest?

- If you were to use bottled water at retail prices to meet all of your weekly water needs, how much would it cost you per week? How would you save money and water?

SUMMARY

- How can we measure water use?
- How can a water meter be useful in reducing wasteful use of water at home?

Suggested Activities

1. Present lessons on the use of water-saving devices for the home, e.g., flow restriction washer for shower-head (made out of either metal or plastic).

2. Students check for leaks in every area of the home using water including kitchen, bathroom, boiler room, and laundry room.

3. Demonstrate water saving tips to students; procedures for washing and cleaning, etc.

4. Industrial Arts Office should receive suggestions from the field for dissemination to the Industrial Arts shops - city-wide.

<u>For Specific Shop Areas</u>

A. Ceramics:

   1. Wash clay off tools in a basin, not under running water.

   2. Rinse hands in catch basin to remove clay, then wash hands under faucet.

B. Transportation:

   Do not wash cars in school.

C. Graphic Arts:

   Informative posters, signs and other materials will be printed for distribution to the school and home.

<u>School Facilities</u>

No tampering with automatic faucet shut-off devices.

Activity Sheets—

Secondary

Activity Sheet S-1, "NEW YORK GETS THE DRY LOOK"..... 34
Activity Sheet S-1, "THE 25 HIGHEST DAMS IN NEW YORK STORE".. 35
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New York Gets the Dry Look

New York gets the dry look

By MARCIA KRAMER

YOU MAY FIND it hard to believe as you slosh home through six inches of slush, but this city is in the middle of a serious water shortage. When it comes to water, New York is only slighly better off than the Mojave Desert.

And, city officials complain, water use has only fallen off slightly since October, when the city declared a drought watch.

"Psychologically, its hard for people to realize there is a water shortage now," says John Cunningham, a water expert with the city's Department of Environmental Protection. "They look out their window and see all that snow and they think we are kidding them when we say we have no water."

Granted, it is hard to imagine that we have a water shortage in the middle of the winter. But water experts point out that what may be a mild inconvenience now will turn into a major headache in the summer when strict controls—perhaps including water rationing—will have to be imposed.

Last week, supplies sunk to 34.3% of capacity, a new low. The Delaware River Reservoirs—which supply half of our water—were at drought level.

To make matters worse, the next few years will bring to the Northeast its most severe drought in modern times, according to Douglas Paine, a Cornell University meteorologist who some time ago predicted this winter's record cold temperatures.

Paine says that the drought will begin next year and will last through 1985. He predicts that a total of no more than 100 inches of rain will fall in most of the region in the four years.

According to Paine's prediction, New York City would receive about 95 inches, including only 16 inches in all of 1984.

Paine's predictions are based on charting sunspot activity. "It's the harbinger of incredibly challenging times that will require a concerted effort, almost like wartime, among federal, state and local governments," he says.

Paine predicts that New York City will receive 27 inches of rainfall next year; 23 inches in 1983; 16 inches in 1984 and 29 inches in 1985—a total of 95 inches. He says that the three worst four-year droughts in the Northeast were 1877-1880 (112 inches); 1962-1965 (115 inches), and in the early 1930s (119 inches).

Paine's message is that bad as the water situation is now, it is only going to get worse.

Another problem complicating the lives of the environmental protection people—who have the job or urging the public to save water—is that most conservation practices deal with summer activities—not with those of midwinter. Sure, they can tell people not to water their lawns or fill their swimming pools, but who does that when the mercury is plunging?

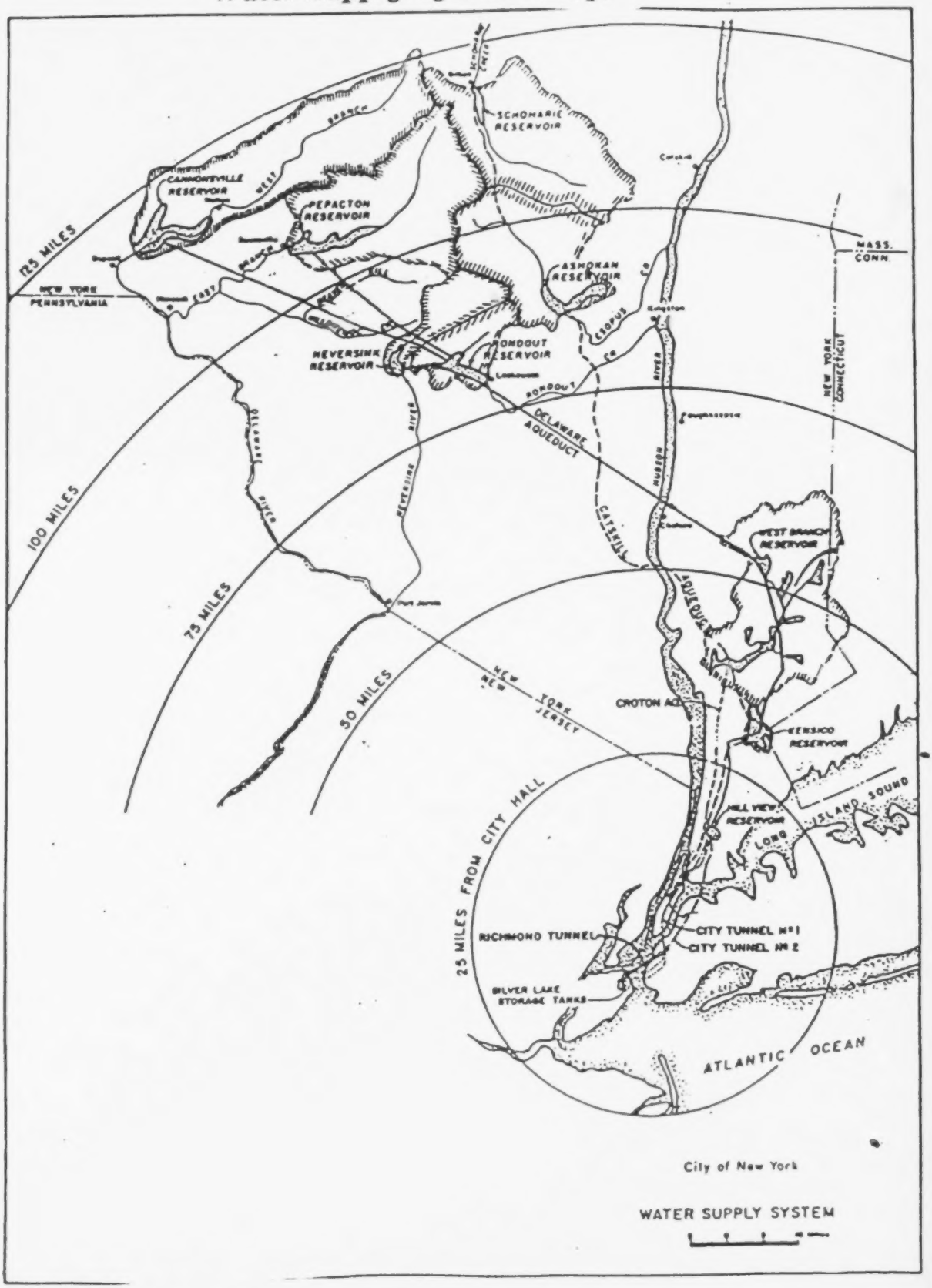
It is evident that there are no short-term cure for our water problems. The answer is to begin conservation practices now so that we can be prepared.

The 25 Highest Dams in New York State

NAME OF DAM	COUNTY	HEIGHT (in feet)	CAPACITY (in acre-feet)
Mount Morris	Livingston	215	33,740
Ashokan	Ulster	213	512,500
Downsville	Delaware	204	609,740
Merriman	Ulster	195	165,000
Neversink Res.	Sullivan	190	142,000
Gilboa Dike	Schoharie	183	67,500
Cannonsville	Delaware	175	450,000
Gilboa	Schoharie	170	95,575
New Croton Res.	Westchester	166	96,000
Moses/Saunders	St. Lawrence	156	797,000
Kensico	Westchester	140	116,560
Caneadea	Allegany	128	27,000
Long Sault	St. Lawrence	127	797,000
East Sidney	Delaware	125	33,550
Sturgeon Pool	Ulster	121	8,000
Swinging Bridge	Sullivan	120	34,700
Ingham's	Fulton/Herkimer	116	4,500
Croton Falls Res.	Putnam	110	49,760
Titicus	Westchester	109	25,500
Blenheim-Gilboa Upper Reservoir	Schoharie	109	18,500
Arkport	Steuben	108	10,800
Cross River	Westchester	104	39,700
Mill River	Westchester	103	3,570
Stewarts Bridge	Saratoga	103	19,360
Almond	Steuben	100	22,900

Source: New York State Department of Environmental Conservation

Water Supply System (Map)



Source: New York City Department of Environmental Protection.

Reading Water Meters

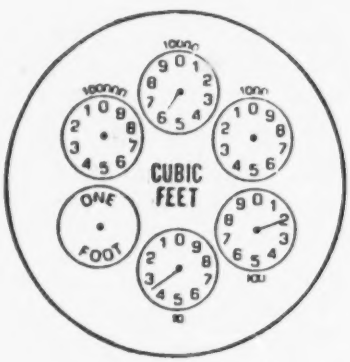
A water meter is used to measure water use in private homes, apartment houses and other buildings. It is usually located inside the building where the water main enters from the street. Its metal cap is hinged to reveal a dial.

Your water meter may look confusing at first, but with practice you can easily learn to read and calculate the amount of water used. Notice that some of the smaller dials move clockwise, while others move counter - clockwise. Notice that each of the small dials ends in multiples of 10.

Some water meters record the amount of water used in cubic feet; others measure the amount of water used in gallons.

1 cubic foot = 7.48 gallons
1 gallon = 0.13368 cubic feet
1 gallon = 231 cubic inches

To record the amount of water used begin by reading the 100,000 dial. If the pointer is in between numbers use the lower of the two numbers. Read and record the value of each dial and add up to find the total.

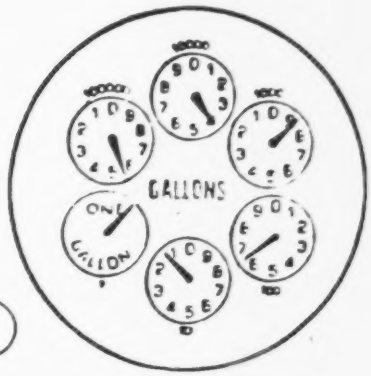


For example, this meter reads:

70,000	(on 100,000 dial)
6,000	(on 10,000 dial)
700	(on 1,000 dial)
20	(on 100 dial)
3	(on 10 dial)
76,723	cubic feet total

Activity Sheet S-4 (continued)

Read and record the amount of water used as indicated by these water meters. Use the blank dials to record your own values.

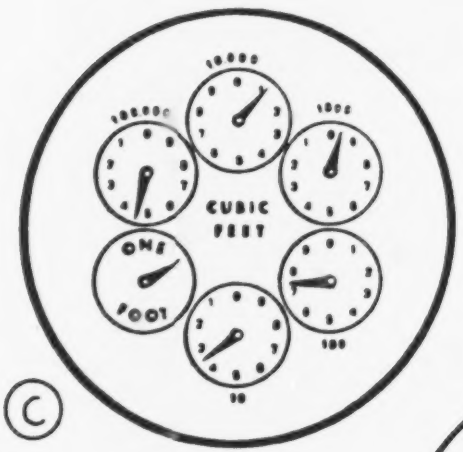


A

A _____

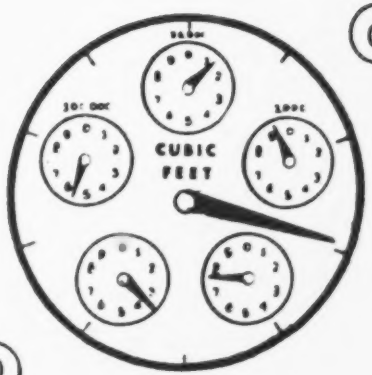
B

B _____



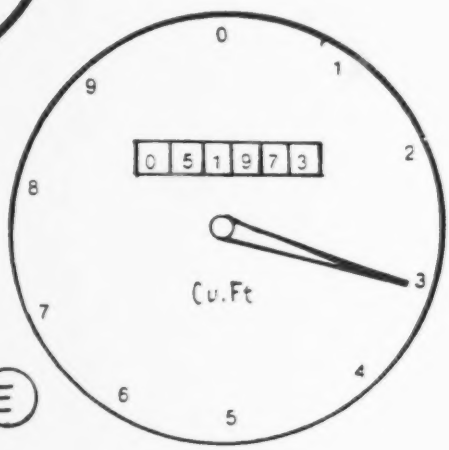
C

C _____



D

D _____



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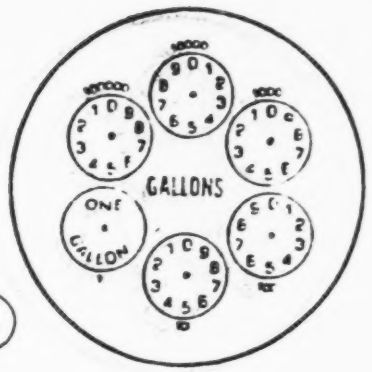
Don't Forget to Indicate Units of Measure

Name _____ Class _____

Water Meters



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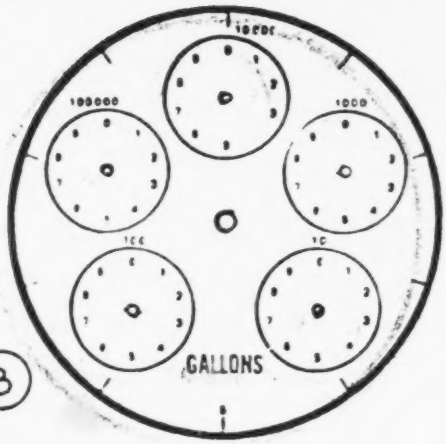

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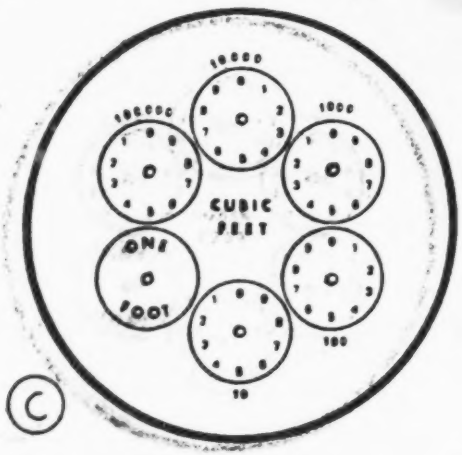

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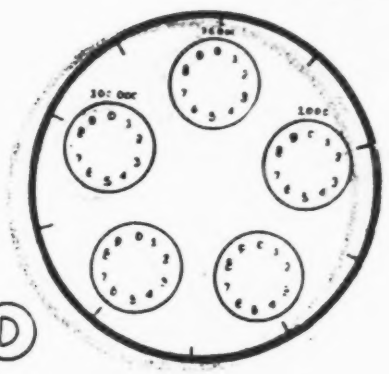

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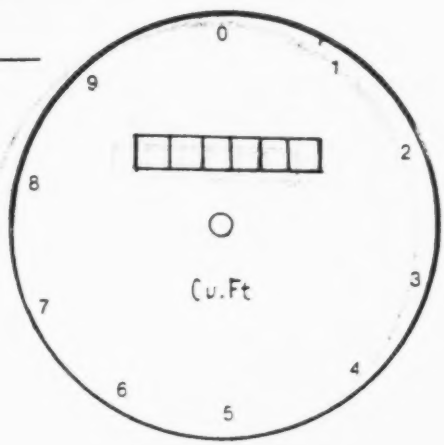

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Don't Forget to Indicate Units of Measure

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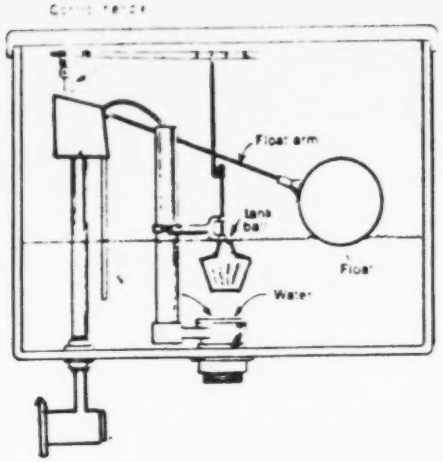
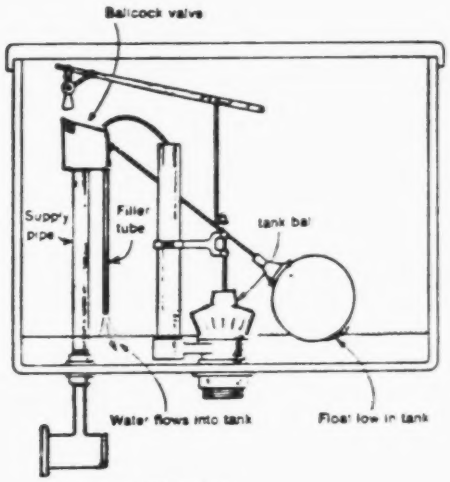
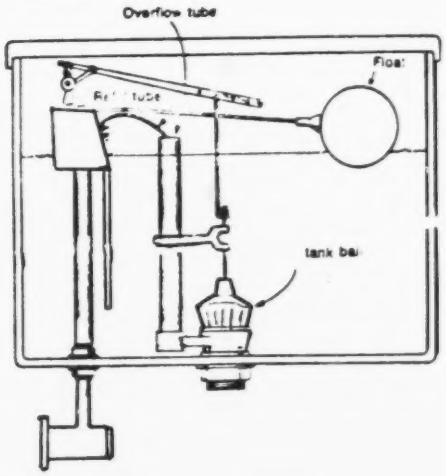
How a Toilet Works



1. When the handle is operated the trip lever raises the lift wire which pulls the tank ball out of the valve seat. Water rushes from the tank into the bowl with force. The float descends to the bottom of the tank.



2. As the float goes downward with the dropping water level, the float arm moves and opens the ballcock valve. This allows fresh water to enter the tank from the supply pipe. By now the user has released the handle and the tank ball falls back into the valve seat sealing the tank, which begins to fill with water.



3. The float and float arm rise as the water level rises. At a predetermined level the float arm moves to close the ballcock valve stopping the flow into the tank. Any excess water escapes through the overflow tube. The ballcock valve also operates a small refill tube which by now has added fresh water to the bowl.

Toilet Tank Problems

A fundamental fixture in our homes is the toilet--which is made up of a bowl and a tank. The toilet is a part of the drainage system, carries waste materials through a drain pipe into the sewer system. It is a combination of many valves, washers, pipes, and shut-off devices. Yet, when properly maintained and used, it seldom needs to be repaired.

How does a toilet work? Quite simply. Water flows from the tank, through the rim of the bowl, and pushes water through a spout into the large, unseen drain pipe. At that point a siphon is formed, pulling the waste material into the drain pipe until the bowl is empty. The remaining clear water flows back into the bowl from the spout which connects the bowl to the drain. It takes from four to six gallons of water to flush a toilet.

After the toilet is flushed, water flows into the tank, and a simple shut-off mechanism prevents overflows. In the most common type of flush toilet found in New York residential buildings, when you pull the lever to flush the toilet, the other end of the lever raises a rubber ball or cover from a hole in the bottom of the tank. The opening of this hole allows water to flow into the bowl and starts the flushing and siphoning action. When the tank is almost empty, the rubber ball sinks back into the hole and an intake valve opens, letting new water flow into the tank. As the tank fills up again, the bulb-like float rises with the water and shuts off the water when it reaches a proper level. Rather simple. But it does require considerate use, or trouble will ensue -- a most unpleasant and expensive type of trouble.

If each time a toilet is flushed, four to six gallons of water are used, an estimated 29 gallons of water per person is used every day just to flush the toilet. That amount can be out in half by using a smaller tank; or by placing a brick or some other heavy, solid object in a waterproof container in a corner of the tank. Placed under the floater this object will displace some of the tank's volume of water. Be sure, however, not to reduce the volume of tank water to a point where it interferes with the operation of the tank or its trap.

Throughout New York City, emergency work is required daily to eliminate stoppages and overflows in toilets. In one high-rise building, several such emergencies were reported on a single spring day. Although the superintendent had cautioned tenants not to throw unsuitable objects into toilet bowls, repair people found the clogging was caused by bottles, diapers, rags, combs, toys, and even spray cans! Others found garbage which had been flushed down into the pipes, causing serious back-ups. Obviously it is important that children not use the toilet as a toy, and that adults not use it as a trash can. The plumbing is not equipped for this!

All tenants in multiple dwellings in New York City are entitled to properly maintained plumbing distribution and drainage systems in their buildings. The city's Housing Maintenance Code requires that landlords provide your apartment with adequate fixtures, such as toilets and sinks. The plumbing and related fixtures must be operational at all hours of the day, and must be kept in good

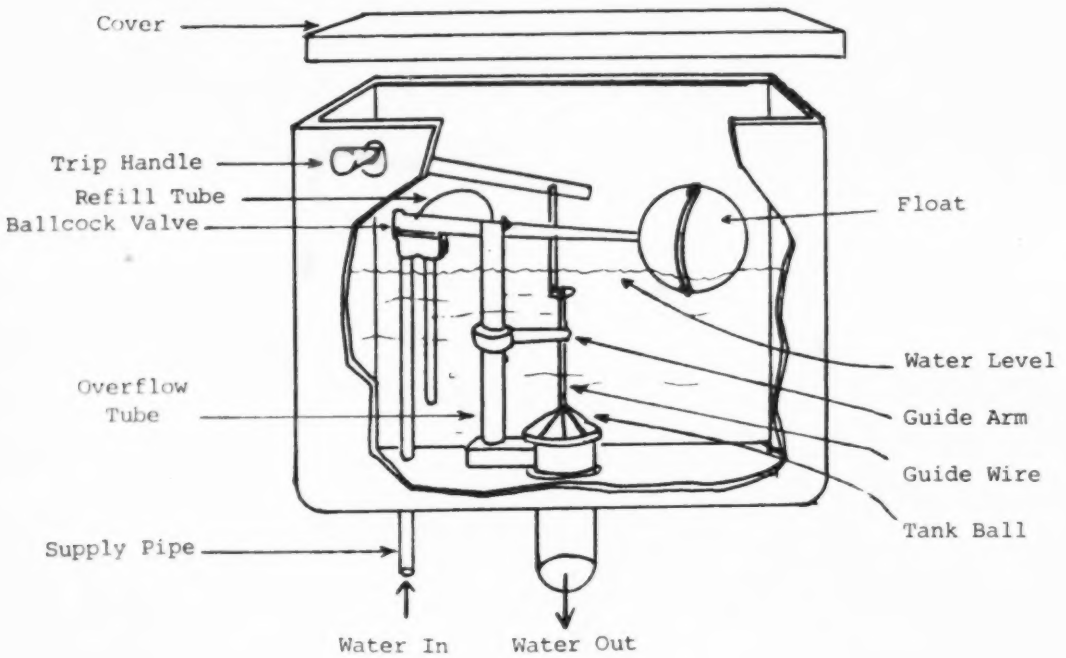
From Home Sick? Try House Sense!, by Dr. Kathleen D. Morin. Copyright (c)1982 by Department of Housing Preservation and Development, New York City. Reprinted by permission.

repair. The code also specifies that the landlord must provide proper drainage from all roofs to carry storm water and prevent its dripping to the ground or causing dampness in walls, ceilings, and open spaces.

If you live in an apartment where these basic requirements are not met, you should request that repairs be made by contacting your superintendent or landlord. If satisfactory results are not obtained, call the Central Complaint Bureau of the city's Department of Housing Preservation and Development at 960-4800.

For complaints about water pollution, water supply, sewer back-ups, and open hydrants, call the city's Department of Environmental Protection, at their Water Complaint number - 966-7500.

Tenants also have a responsibility for the proper maintenance and use of the plumbing facilities provided in their building, and they should act appropriately and use water wisely.



Solving Toilet Tank Problems

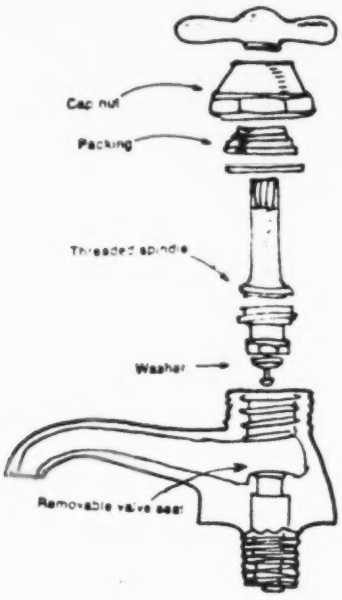
Problem	Cause	Solution
Water keeps running	Tank float may have water in it and cannot float properly.	Unscrew float and shake it. If water is heard inside, replace with a new float.
Note: To test for leaks, place some dry tissue on the brim of the bowl and see if water leaking from tank wets paper. Or try pouring some food coloring in the tank. Does any color seep into the bowl when the toilet has not been flushed?	Tank ball may not be seated properly, or may be badly worn. Handle may have to be jiggled to stop the flow of water out of the tank.	Remove cover from tank. Flush water and observe action of ball and lift wire. You will have to operate handle repeatedly to study ball movement. . Adjust lift wires with thumb screws on the overflow tube to ensure smooth action. . Replace a ball that is cracked, brittle, deformed or unable to make a good seal with the valveseat.
	Water level is too high: constant excess goes into overflow tube.	. Bend the float rod slightly downward. This will cause the ballcock to close sooner. The result will be a lower water level in tank.
	Water level goes above overflow pipe and float: ballcock valve is not operating.	. If bending the float downward does not work, the ballcock valve may need to be repaired or replaced. - There is a washer in the ballcock that can be replaced. Water must first be shut off to the toilet tank. - If after consulting a good how-to plumbing guide, you don't feel you can handle the repair, call a plumber!

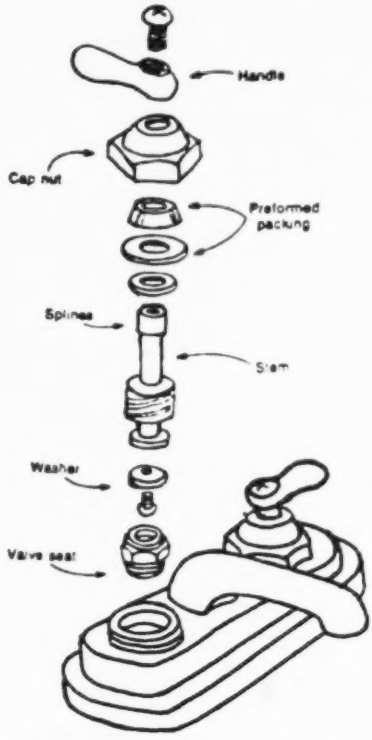
Stop That Drip!

The dripping faucet is the symbol of water waste. If we multiplied the number of dripping faucets in New York City - probably hundreds of thousands - by the average daily loss due to individual leaky faucets, the total amount of water wasted would amaze us.

As few as thirty drops per minute may result in a gallon wasted each day. A steady flow 1/32 inch wide wastes about 25 gallons per day, while a flow 1/8 inch thick results in about 400 gallons of water wasted each day. Fortunately, faucets are usually easy to repair.

Faucets for use in the home come in an enormous range of styles and design. But you can be sure that your faucet has washers inside and these are relatively simple to replace.





If a plumber, superintendent, or custodian is not available and you must do the repair, remember to first turn off the water to that faucet. The cut-off valve is usually located under a sink, although some valves may be in the walls and not easily accessible. In a private home you may turn off the main valve, located near the water meter. This will turn off the water supply to the entire house.

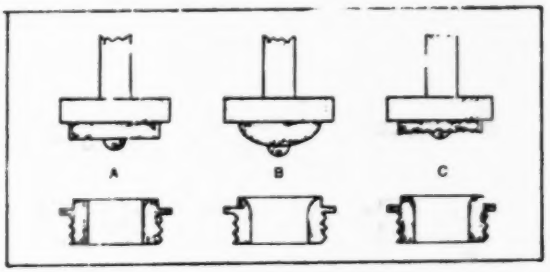
Assemble your tools (wrenches--open-ended, adjustable, or monkey wrench with smooth jaw faces so that chrome work will not be damaged; screwdriver--flat or Phillips--to remove faucet handle; washers; packing; and rags).

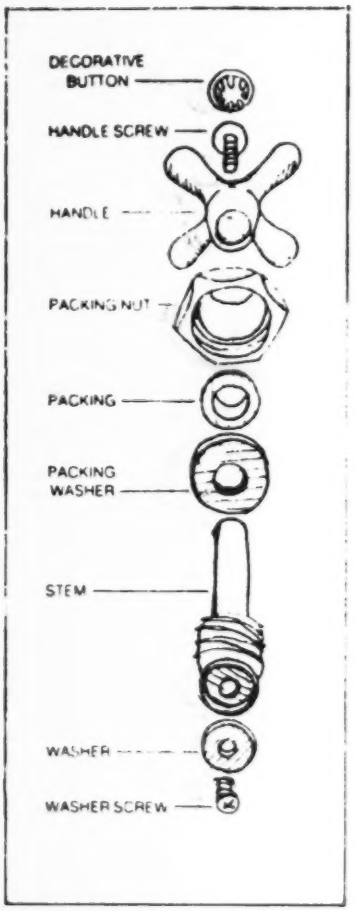
Next, open the faucet to allow any accumulated water to escape. Then remove the handle by loosening the screw that holds it in place on the stem. Sometimes this screw is covered with a decorative metal cap, which can be pried off carefully with a knife or sharp screwdriver.

Next, remove the lock-nut (or cap-nut) which holds the valve stem assembly in place. Use a suitable wrench for this purpose. A small amount of water may well up when the lock-nut is loosened, so keep a rag on hand for wipe-ups. Now withdraw the stem assembly and inspect the washer for wear. The washer will be held in place by a screw or nut, which can be easily removed. Replace the old washer with an identical new one. If you do not have replacements, take the valve stem assembly with the washer to a plumbing supply or hardware store for an exact replacement.

The next step is to reassemble the faucet and turn the water supply back on. If the faucet still leaks, you may have inserted the washer improperly or used the wrong size or style washer. Yet another cause of leaking might be a worn seat--the specially shaped opening into which the washer fits when the faucet is closed.

Valve seats are replaceable but you may need a special tool for this. Visit the plumbing supply shop again and get some expert advice.





If water is seeping out of the faucet around the stem and handle, the packing may need replacement. First tighten the packing nut down snugly. This single action may be all that is needed to stop that drip. If not, remove the handle and packing nut and examine the packing. Self-forming packing looks rope-like and is wound around the stem to seal out leaks. Replace this type of packing with duplicate material. Packing washers are used in some faucets. These are pre-formed and must also be replaced with an exact duplicate.

Water Use in Daily Activities

Activity Sheet S-10

(Amounts are Approximate)

IN NORMAL HOUSEHOLD		IN CONSERVATION MINDED HOUSEHOLD	
long shower	25 gal	three minute shower	4-6 gal
full tub bath	36 gal	tub with low water	10 gal
toilet flush	5-7 gal	with tank displacement (plastic bottle filled with water)	4 gal
shave with running water	3-5 gal	shave in basin of water	1 gal
handwashing	2-3 gal	wash in full basin	1 gal
brushing teeth	2-3 gal	wet brush, rinse briefly	1/2 gal

NOTE: Bathroom activity accounts for 75% of typical home use of water supply. Effect savings here!

clothes washing full cycle	60 gal	short cycle	25-30 gal
dishwashing with tap running	10-30 gal	in dish pan	5 gal
dishwasher-full cycle	16 gal	dishwasher-short cycle	7 gal

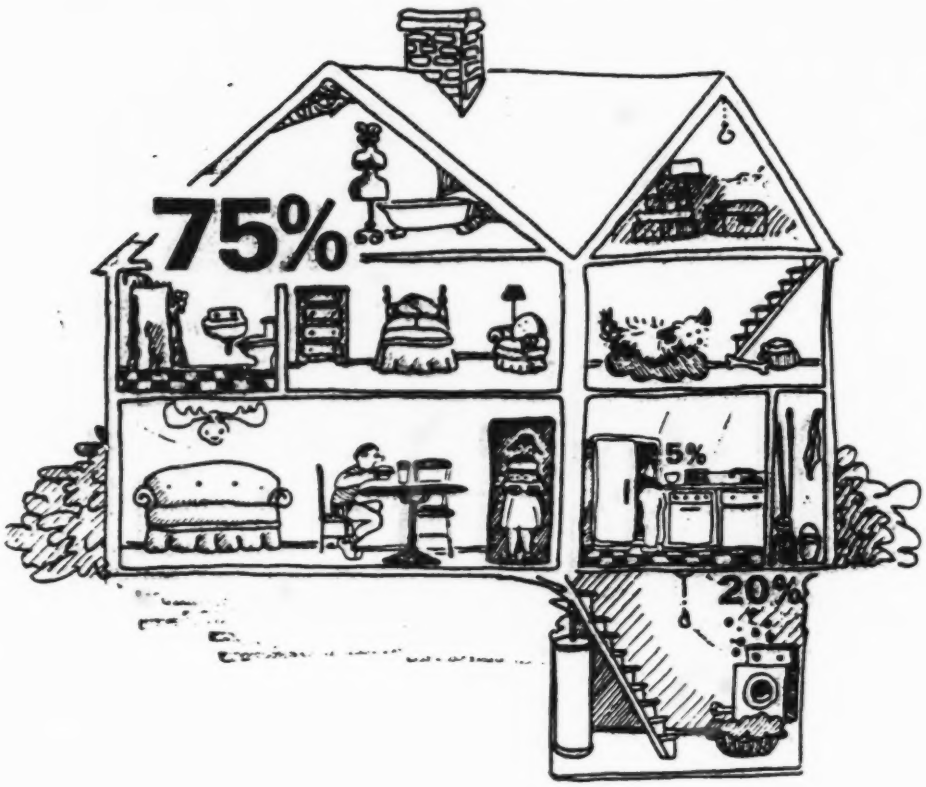
NOTE: Kitchen and laundry activity accounts for 20% of demand. Drinking and cooking require 5% of typical household water supply.

WATER WASTERS

garden hose, fully open (for washing cars and sidewalks, watering lawns or filling pools)	=	10 gals/min.
leaky faucets 1/32 inch leak	=	25 gals/day
1/8 inch leak	=	400 gals/day
fire hydrants fully open	=	1000 gals/min
with sprinkler cap	=	25 gals/min

Open hydrants should be closed by an adult or reported to the local fire station or police precinct, or call 966-7500.

INDOOR WATER USE
75% in the Bathroom
20% in the Kitchen and Laundry
5% for Cooking and Drinking



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Resources for the Teacher

New York City Water Supply

WATER COLLECTION

New York City and several Westchester county communities obtain their water from three upstate reservoir systems which include 18 reservoirs, four controlled lakes and a storage capacity of approximately 550 billion gallons of water.

The entire system can be depended upon to safely furnish an average of 1.29 billion gallons of water per day, even during a drought. However, since consumption normally averaged 1.555 billion gallons of water a day, the safe yield was exceeded by 265 million gallons a day. As a result of the city's recent conservation efforts, daily consumption has been reduced to approximately 1.46 billion gallons.

Water is conveyed from the upstate reservoirs by gravity through large aqueducts ranging in size up to 19 1/2 feet in diameter. Within the city it is distributed through four local reservoirs and two major tunnels. A third tunnel is under construction now and will supplement the two present supply tunnels.

WATER DISTRIBUTION

The city's distribution system consists of a gridiron network of water mains ranging in size from six to 84 inches in diameter. It contains approximately 6,300 miles of pipe, 184,000 valves and 98,000 fire hydrants.

The water pressure is regulated so that it ranges between 35-60 pounds per square inch at street level. This range is sufficient to supply water to the top of a five or six-story building. Normally, about 95 percent of the total consumption is delivered to the network solely under the force of gravity. It is necessary to pump the remaining five percent from delivery to areas of higher elevation in order to keep the pressure within the desire range.

SYSTEM MAINTENANCE

The Bureau of Water Supply employs about 1,250 people who are involved in the operation and maintenance of the water supply system. These include engineers, adiminstrative personnel, foremen and superintendents, inspectors, and unskilled laborers.

DEP's Functions and Responsibilities: An Overview. New York City Department of Environmental Protection.

The Department has an emergency status similar to the Police and Fire Departments and operates on a round-the-clock basis throughout the year.

The owner of a building to which water is supplied is responsible for the maintenance of the service connections which extend from within the building to the City main located under the street. The owner must engage a licensed plumber to install or repair these connections. Currently, there are about 319,000 service connections in the City. Any pumping that may be required to furnish water to the upper stories of tall buildings, usually pumped into roof tanks, must be provided by the owner.

WATER QUALITY

At the time, it is not necessary to filter our water since it is inherently of high quality and the long periods of storage in the collecting and distribution reservoirs serve to reduce the bacterial content and the turbidity. Before the water reaches the consumer, all of it is chlorinated and fluoridated, and some of it is aerated. When required, copper sulfate is used for algae control and occasionally alum for turbidity.

The City owns and operates seven laboratories with approximately 40 bacteriologists, engineers, and chemists who monitor the water. At the labs, 40,000 samples a year are collected and 400,000 annual analyses are performed. The checks are made for 60 different substances, including heavy metals and trace organics. The monitoring program is based on federal and state health agency requirements.

In addition to monitoring, we have watershed inspectors who continuously run sanitary surveys and maintain constant surveillance of our watersheds. They cover not only the reservoirs, but also the streams and treated wastewater which feed into the reservoirs.

The City owns and operates ten sewage treatment plants to treat sewage from communities in the watershed areas. We achieve 98 percent removal of organic pollutants. The treatment system includes intermittent sand filters which biologically break down pollutants in the sewage.

WATER COSTS

Property owners pay 66 cents per hundreds cubic feet for the delivery of fresh water if their buildings are metered. If a building is not metered, the owner pays an amount determined by a formula based on the property frontage and the number of appurtenances (shower heads, taps, etc.) in the building.

Sewage rates are 60 percent of the fresh water bill.

24-HOUR COMPLAINT NUMBER -- 966-7500

NEW YORK CITY WATER SUPPLY (Reservoirs)

New York City residents use about 1.36 billion gallons of fresh water each day. The present water supply system represents an expenditure of more than $1.5 billion. The water is obtained primarily from three systems -- Croton, Catskill, and Delaware.

The major water supply facilities for New York City were designed and constructed by the City's Board of Water Supply. Upon completion, the facilities were transferred for maintenance and operation to the jurisdiction of the City's Department of Environmental Protection's Bureau of Water Supply. In 1978, the Board of Water Supply was abolished and its functions were transferred to the Bureau of Water Supply.

DISTRIBUTION -- From Upstate to the City

The rain and snow that fall on the ground in the watershed areas (land areas in which falling or flowing water drains to the lowest point) drain into brooks and streams which in turn form creeks and rivers. Dams are built across these creeks and rivers to impound their waters and to form artificial lakes or storage reservoirs. From the controlled lakes and storage reservoirs, the water is drained to meet the daily requirements of the City and some upstate communities to which the City supplies water.

The City owns eighteen reservoirs and four controlled lakes in some 1,950 square miles of watershed area located in nine upstate counties. Of this the City owns 90,000 acres (the combined size of Brooklyn, Manhattan, and the Bronx) on which it pays annual taxes of approximately $28 million to the communities.

The storage capacity of the reservoirs and controlled lakes is 550 billion gallons of water. Water is conveyed from these storage areas by gravity through large aqueducts ranging in size up to 19 feet in diameter. Within the city, it is distributed through four local reservoirs and two major tunnels. The entire system can safely be depended on to furnish an average of 1.290 billion gallons a day, even during drought periods.

The Croton system consists of 12 reservoirs and four controlled lakes, and supplies approximately 10% of New York's daily needs. The oldest of the three supply systems, Croton was originally constructed in 1842, and spans parts of Putnam, Dutchess and Westchester Counties. The usable storage capacity of the Croton system is 86.6 billion gallons.

The Catskill system includes two reservoirs and supplies up to 40% of the City's daily needs. The eystem is located approximately 125 miles from the City on the New York-Pennsylvania border. Water from the Catskill is conveyed to New York by aqueduct. The usable storage capacity of the Catskill system is 140.5 billion gallons.

The Delaware system is the largest of the three supply systems. It includes three reservoirs and accounts for 50% of the City's daily water needs. The Delaware system is located adjacent to the Catskill system, and its water is, likewise, delivered to the City via aqueduct. The usable storage capacity of the Delaware system is 270.8 billion gallons. Rondout reservoir is fed by water from the Delaware reservoirs, as well as from local stsreams. Its usable storage capacity, which is counted in the City's total usable water storage figure, is 49.6 billion gallons.

The three systems include 18 reservoirs, four controlled lakes and a storage capacity of approximately 550 billion gallons of water. The entire system can be depended upon to safely furnish an average of 1.290 billion gallons of water per day, even during drought. However since the City normally consumes 1.555 billion gallons a day, it is exceeding the "safe yield" of the system by 265 million gallons a day.

In addition the City can utilize -- in emergencies -- up to 100 million gallons per day of Hudson River water through use of a pumping station located about 50 miles upstate from Manhattan.

TUNNELS

The City has two tunnels which carry water from the Hillview Reservoir to the five boroughs. A third tunnel is under construction now and will supplement the two present supply tunnels.

City Tunnel #1 is 18 miles long, up to 15' in diameter and averages a depth of 365 feet. Completed in 1915, it carries Delaware water to the five boroughs.

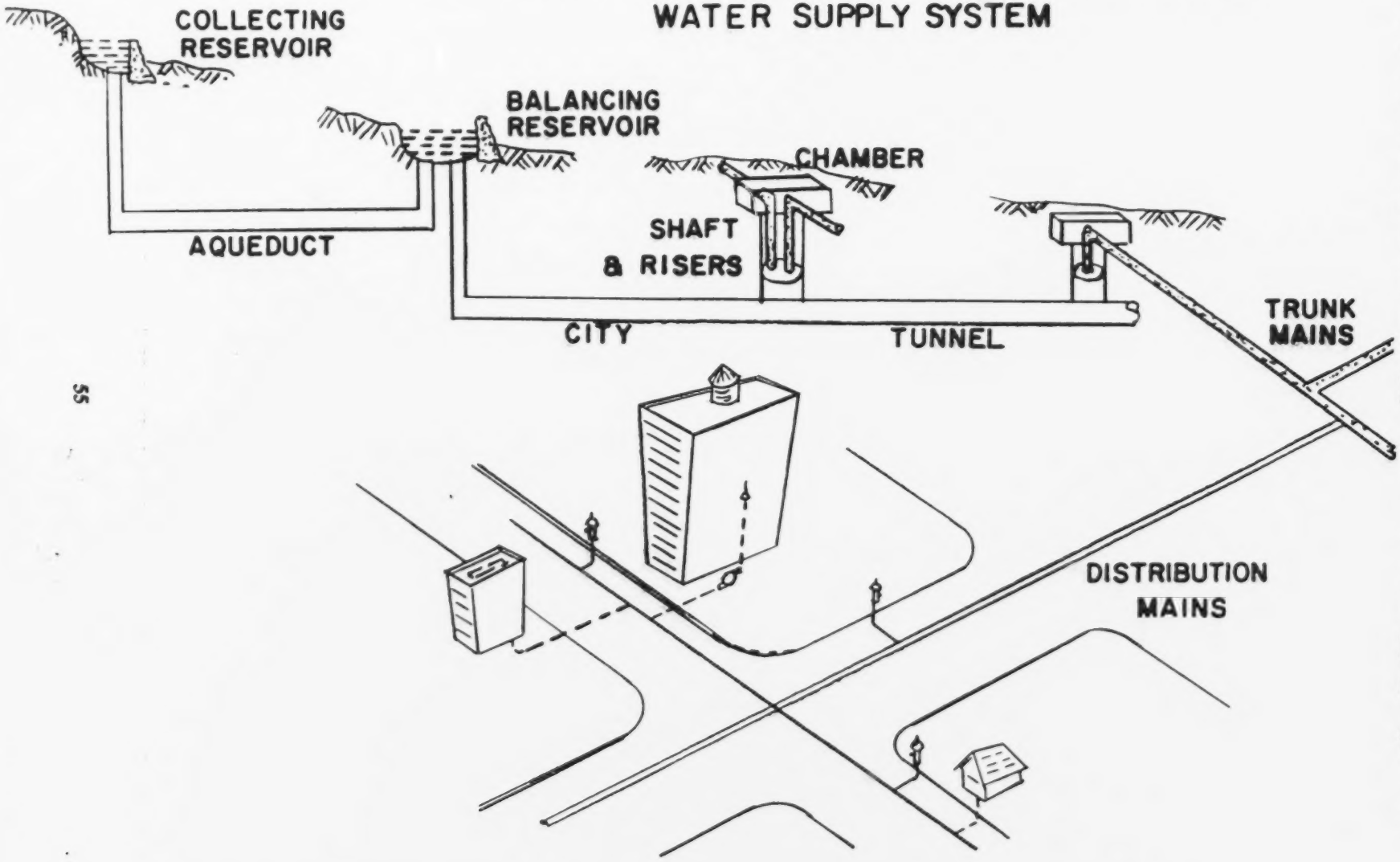
City Tunnel #2 is 20 miles long, up to 17' in diameter and averages a depth of 500 feet. Completed in 1936, it extends from Hillview Reservoir through the Bronx and Queens, and hooks up with Tunnel #1 in Brooklyn. In 1970, the 10' diameter, 5 mile long Richmond Tunnel which connects with Tunnel #2 in Brooklyn and carries water to Staten Island was completed.

City Tunnel #3, under construction by the Bureau of Water Supply, has been termed "one of the engineering wonders of the world." Costing upwards of $1 billion for the first stage, the tunnel will connect all five boroughs and for the first time, house underground control centers.

UPSTATE COMMUNITIES

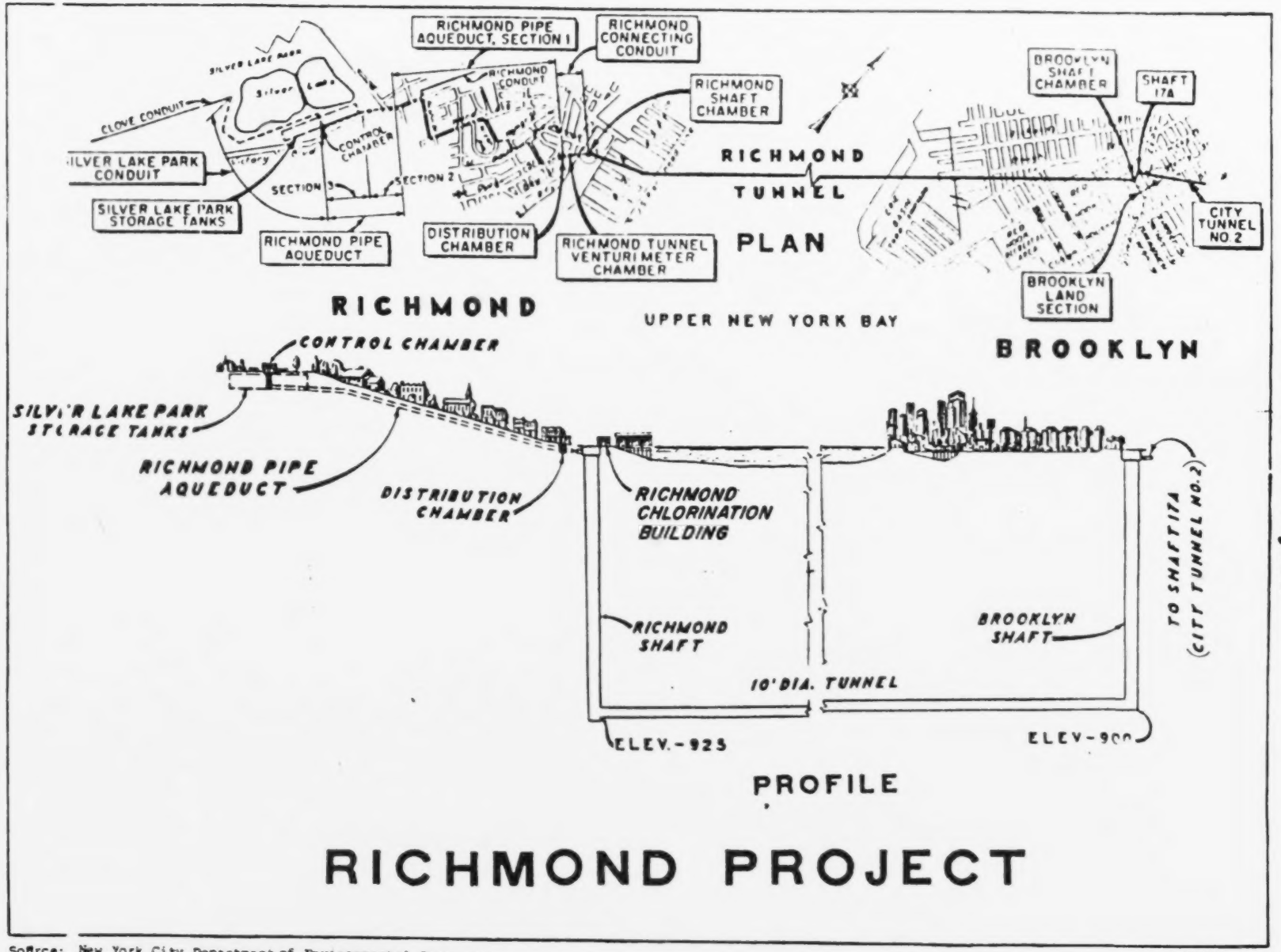
New York State law mandates that local communities in the countries through which our water supply system passes are permitted to tap the City's water supply system. Therefore, the City presently supplies about 112 million gallons per day to some upstate communities at cost.

NEW YORK CITY'S GRAVITY-FED, ENERGY-FREE WATER SUPPLY SYSTEM



Source: New York City Department of Environmental Protection.

NYC's Gravity-Fed, Energy-Free Water Supply System



RICHMOND PROJECT

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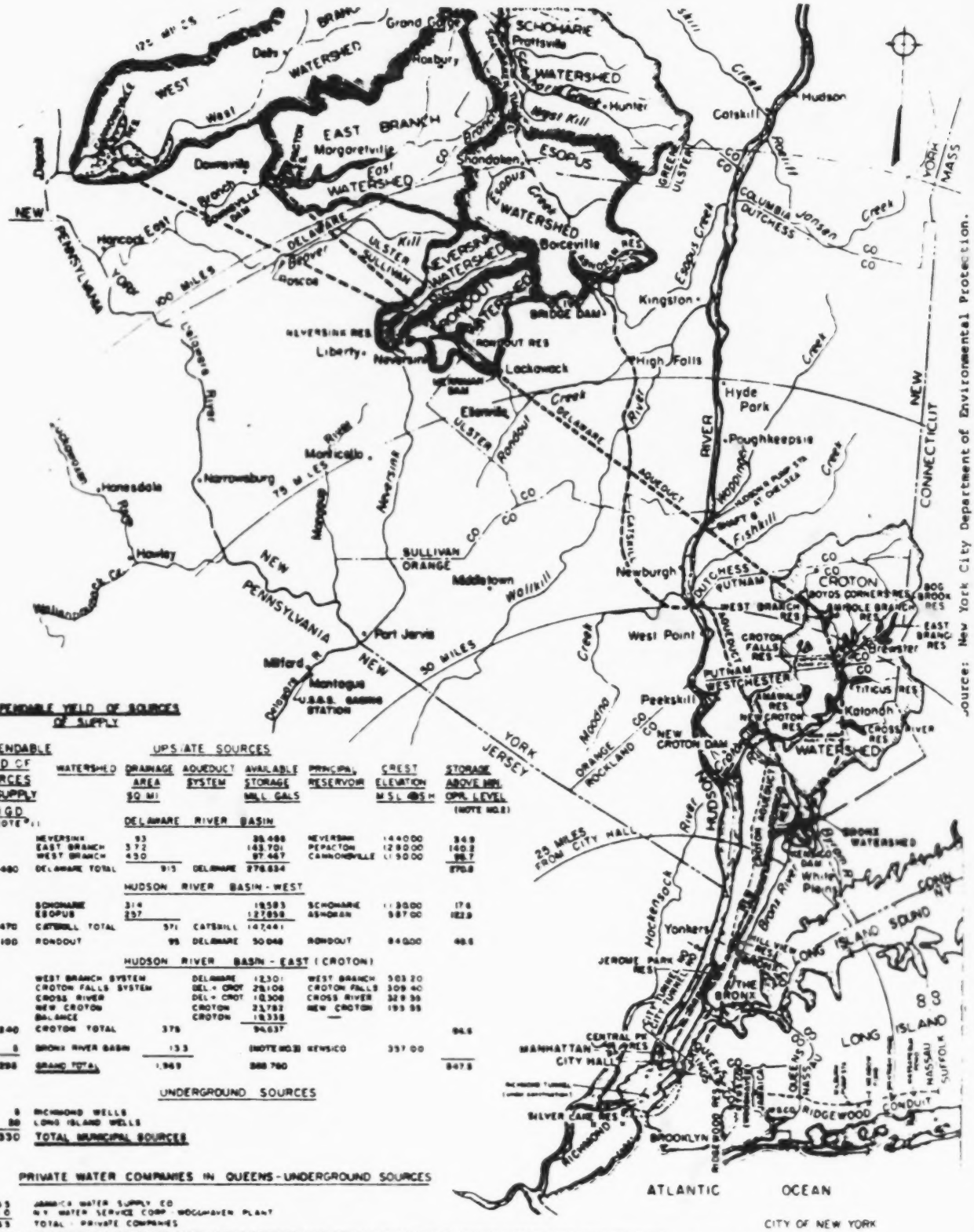
Source: New York City Department of Environmental Protection.

62

Richmond Project

The Water Supply of The City of New York
Sources of Water Supply (Map)



Source: New York City Department of Environmental Protection.

DEPENDABLE YIELD OF SOURCES OF SUPPLY

DEPENDABLE YIELD OF SOURCES OF SUPPLY MGD (NOTE 1)	WATERSHED	UPSTATE SOURCES: DRAINAGE AREA SQ MI	AQUEDUCT SYSTEM	AVAILABLE STORAGE MILL GALS	PRINCIPAL RESERVOIR	CREST ELEVATION M S L @ S H	STORAGE ABOVE MIN OPR LEVEL (NOTE NO 2)
		DELAWARE RIVER BASIN					
	NEVERSINK	93		38,488	NEVERSINK	1440.00	34.9
	EAST BRANCH	372		143,701	PEPACTON	1280.00	140.8
	WEST BRANCH	430		97,447	CANNONSVILLE	1150.00	98.7
480	DELAWARE TOTAL	915	DELAWARE	279,634			274.0
		HUDSON RIVER BASIN - WEST					
	SCHOHARIE	314		19,583	SCHOHARIE	1130.00	17.6
	ESOPUS	257		127,858	ASHOKAN	887.00	182.9
470	CATSKILL TOTAL	571	CATSKILL	147,441			
100	RONDOUT	95	DELAWARE	50,048	RONDOUT	840.00	48.6
		HUDSON RIVER BASIN - EAST (CROTON)					
	WEST BRANCH SYSTEM		DELAWARE	12,301	WEST BRANCH	503.20	
	CROTON FALLS SYSTEM		DEL + CROT	28,106	CROTON FALLS	309.40	
	CROSS RIVER		DEL + CROT	10,308	CROSS RIVER	329.35	
	NEW CROTON		CROTON	33,782	NEW CROTON	193.35	
	BALANCE		CROTON	19,338			
240	CROTON TOTAL	375		94,837			94.5
8	BRONX RIVER BASIN	133		(NOTE NO 3)	KENSICO	357.00	
1,298	GRAND TOTAL	1,949		388,780			847.8

UNDERGROUND SOURCES

8	RICHMOND WELLS
80	LONG ISLAND WELLS
1,330	TOTAL MUNICIPAL SOURCES

PRIVATE WATER COMPANIES IN QUEENS - UNDERGROUND SOURCES

3.3	JAMAICA WATER SUPPLY CO
1.0	N Y WATER SERVICE CORP WOODHAVEN PLANT
4.3	TOTAL PRIVATE COMPANIES

NOTES 1 THE DEPENDABLE YIELDS ARE BASED UPON A COMBINED OPERATION OF THE CATSKILL-CROTON SYSTEMS AND UPON RELEASING WATER FROM THE DELAWARE RESERVOIRS TO MAINTAIN A MINIMUM FLOW OF 1750 C F S AT MONTAGUE AS STIPULATED IN THE 1954 AMENDED DECREE OF THE U.S. SUPREME COURT

2. THE MINIMUM OPERATING LEVEL IS THE LOWEST ELEVATION OF A RESERVOIR'S WATER SURFACE THAT WILL MAINTAIN A DRAFT ON THE WITHDRAWAL AQUEDUCT AT ITS OPERATING CAPACITY.

3 KENSICO RESERVOIR IS USED FOR REGULATION AND SAFETY AND ITS STORAGE CAPACITY OF 30,973 M G IS NOT INCLUDED IN IMPOUNDMENT STORAGE

CITY OF NEW YORK
Bureau of Water Supply
SOURCES OF WATER SUPPLY
57 DEC 1968

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Audio Visual and Published Materials

The Adventures of Captain Hydro: This two-part filmstrip is a full-color version of the comic material found in *The Official Capt. Hydro Water Conservation Workbook*. Essentially it is to be used in conjunction with the workbook on the upper elementary level, but might serve in other grades to introduce "our hero." Copies may be purchased from EBMUD.

Contact: Public Information Office
East Bay Municipal Utility District
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(415) 835-3000, Ext 216

In addition to films and aids from district and county media centers, many companies and governmental agencies maintain audio-visual libraries from which teachers can procure free films. The following local outlets might be contacted for their catalogs of materials:

Association-Sterling Films (distributor of free-loan films for the Environmental Protection Agency, Standard Oil Company and similar companies and agencies).

Portland, Oregon Exchange (Alaska, Wash., Ore., Idaho, Mont. & Wyo.), 915 N.W. 19th Avenue, Portland, Oregon 97209. (503) 226-7695.

Dublin, Calif. Exchange (No. Calif., Nevada and Utah), 6644 Sierra Lane, Dublin, California 94566. (415) 829-2300.

Sun Valley, Calif. Exchange (So. Calif., Hawaii and Arizona), 7838 San Fernando Road, Sun Valley, California 91352. (213) 767-7400.

Minneapolis, Minn. Exchange (Minn., N. Dak., S. Dak. and No. Wisc.), 6420 West Lake Street, Minneapolis, Minnesota 55426. (612) 920-2095.

La Grange, Ill. Exchange (Ill., Nebr., Iowa, So. Wisc., Mich. and Ind.), 512 Burlington Avenue, La Grange, Illinois 60525. Chicagoans call BL2-1898. All others call (312) 352-3377.

Dallas, Texas Exchange (Tex., Colo., N. Mex., Kans., Okla., Mo., Ark. and Louisiana), 8615 Directors Row, Dallas, Texas 75247. (214) 638-6791.

Littleton, Mass. Exchange (Mass., Me., Vt., N.H., R.I. and Conn.), 410 Great Road, Littleton, Massachusetts 01460. (617) 486-3518.

Ridgefield, New Jersey Exchange (N.J., Eastern N.Y., Eastern Pa., Del. and Maryland), 600 Grand Avenue, Ridgefield, New Jersey 07657. New York City call PE6-9693. All others call (201) 943-8200.

Oakmont, Penn. Exchange (West Pa., Western N.Y., Ohio, Ky., W. Va., and Virginia), 324 Delaware Avenue, Oakmont, Pennsylvania 15139. Pittsburgh call (412) 362-5011. All others call (412) 828-5900.

Atlanta, Ga. Exchange (Ga., Tenn., N.C., S.C., Miss., Ala. and Fla.), 5797 New Peachtree Road, Atlanta, Georgia 30340. (404) 458-6251.

Atlantic-Richfield Film Library, 400 S. El Camino Real, San Mateo, Calif. 94402. (415) 348-8600.

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Most of the outstanding publications in the general field of environmental education are included in the bibliographies above. Particular sources are indicated for individual topics in the lesson notes. However, for reference work in the specific areas of water resources, supply, conservation and/or pollution, the following sources are suggested:

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